Analysis of Stress and Deformation in PALF-reinforced Prosthetic Composite

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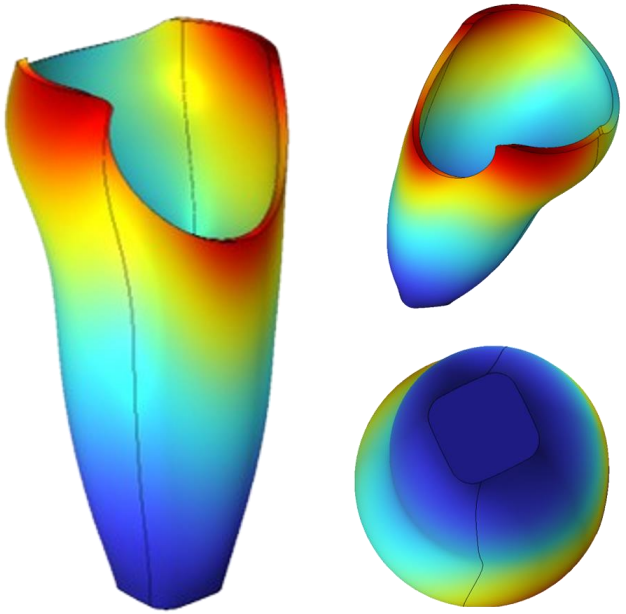

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Introduction

- Globally, there is a rising demand for sustainable materials and technologies that are:[1]

- Plant fibre polymer composites are attractive due to their appealing mechanical properties, the potential for biodegradability, affordability, low-energy demand for processing, and availability.

Introduction…cont'd

- Pineapple leaf fibres (PALF), often considered agricultural waste, have shown promising properties for polymer reinforcement in previous research[2,3].

polymers

MDPI

Article

The Influence of Pineapple Leaf Fiber Orientation and Volume Fraction on Methyl Methacrylate-Based Polymer Matrix for Prosthetic Socket Application

Eric Worlawoe Gaba [1], Bernard O. Asimeng [1], Elsie Effah Kaufmann [1,2], E. Johan Foster [3] and Elvis K. Tiburu [1,4,*]

- However, there has been little effort to investigate how PALF composite can be applied to prosthetic socket fabrication.

Introduction

- **Rationale**: Understand how PALF can be a good material for developing sustainable prostheses.

- **Challenge**: Limited experimental data on the performance behaviour of the PALF composite with a real pilot.

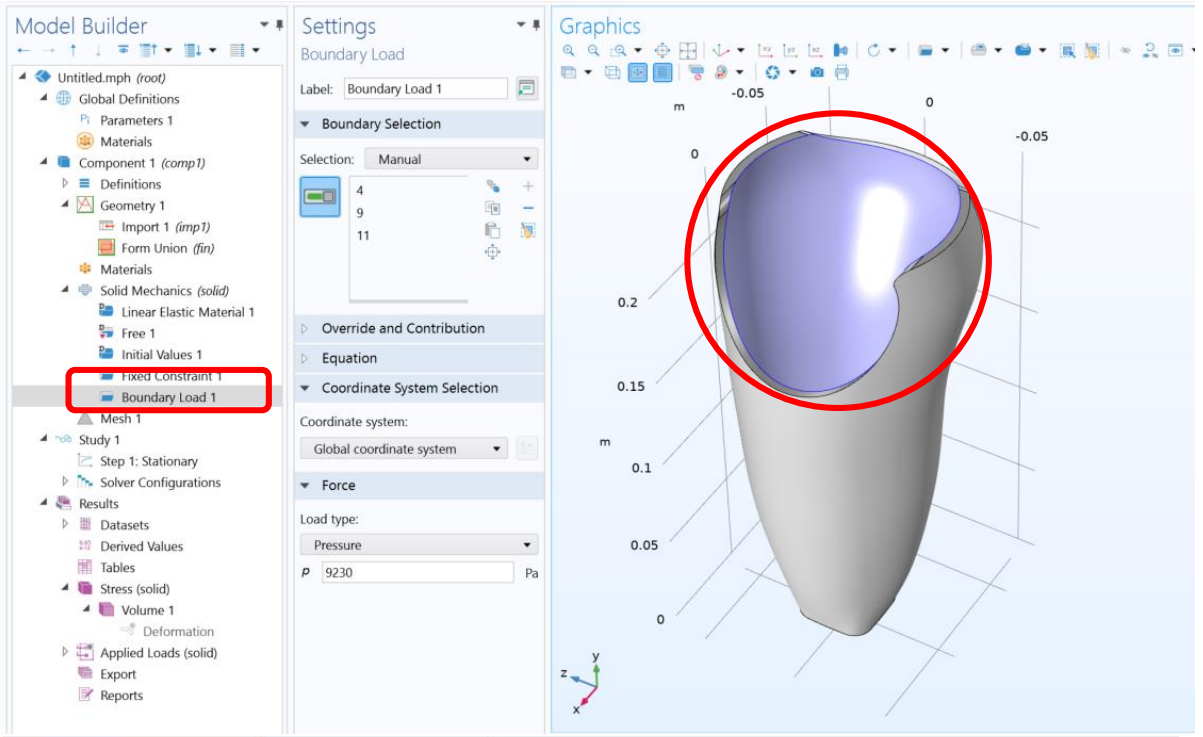
- **Goal**: Determine the potential range of stresses and deformation behaviour of a modelled transtibial prosthetic socket (PS) using experimental data on PALF composite[3].

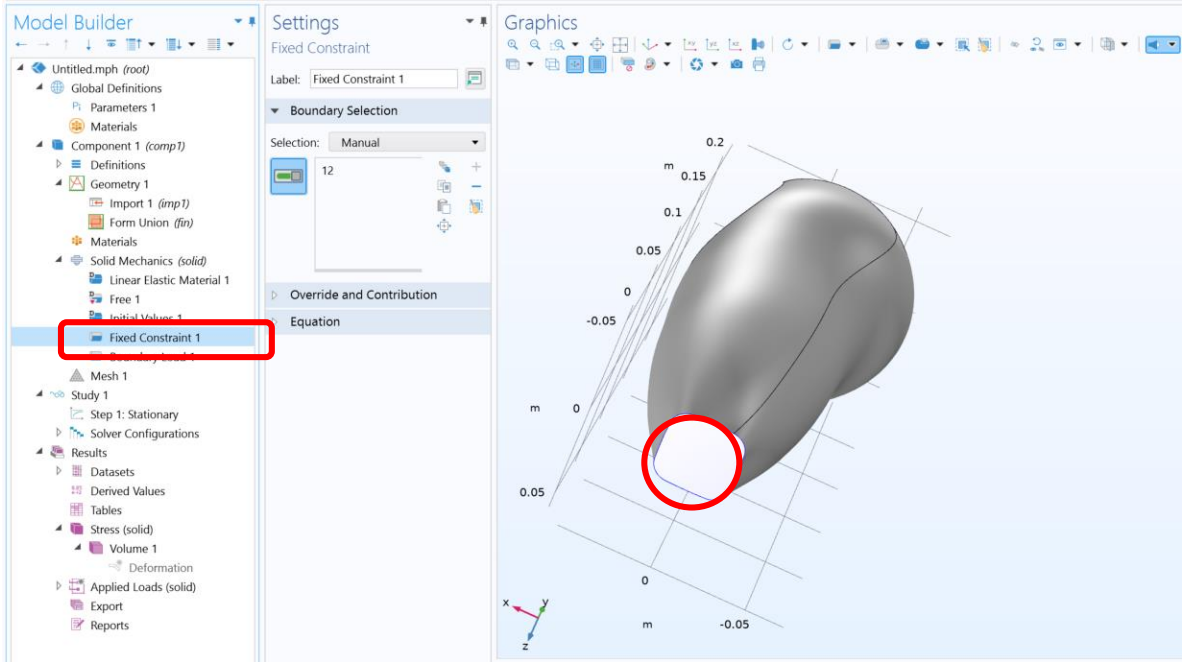
Methods

- Experimental and Finite Element Analysis.

- Why modelling?
  - Very low-risk platform
  - Time efficiency
  - Allowed for multiple simulations on PS composites and iteration at low resource cost.

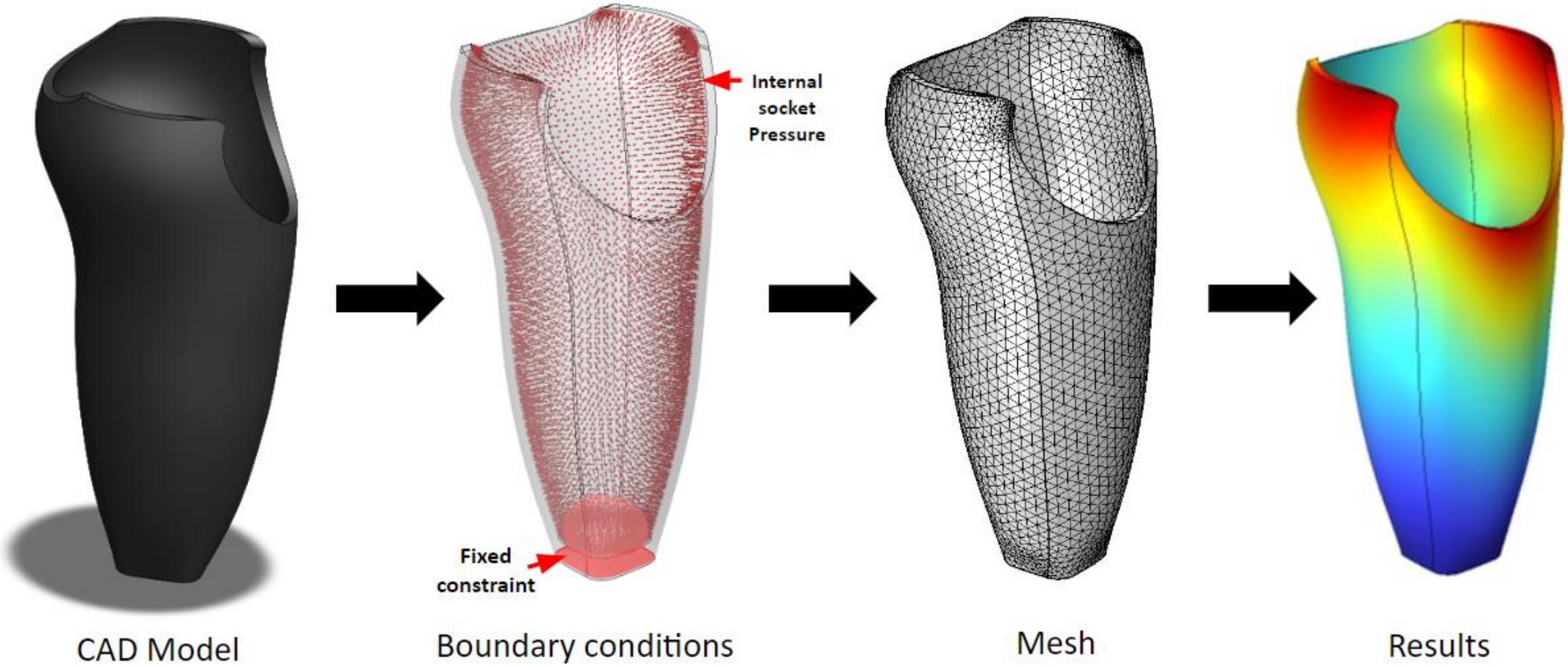
- Static Structural analysis: mimic the midstance phase of gait.





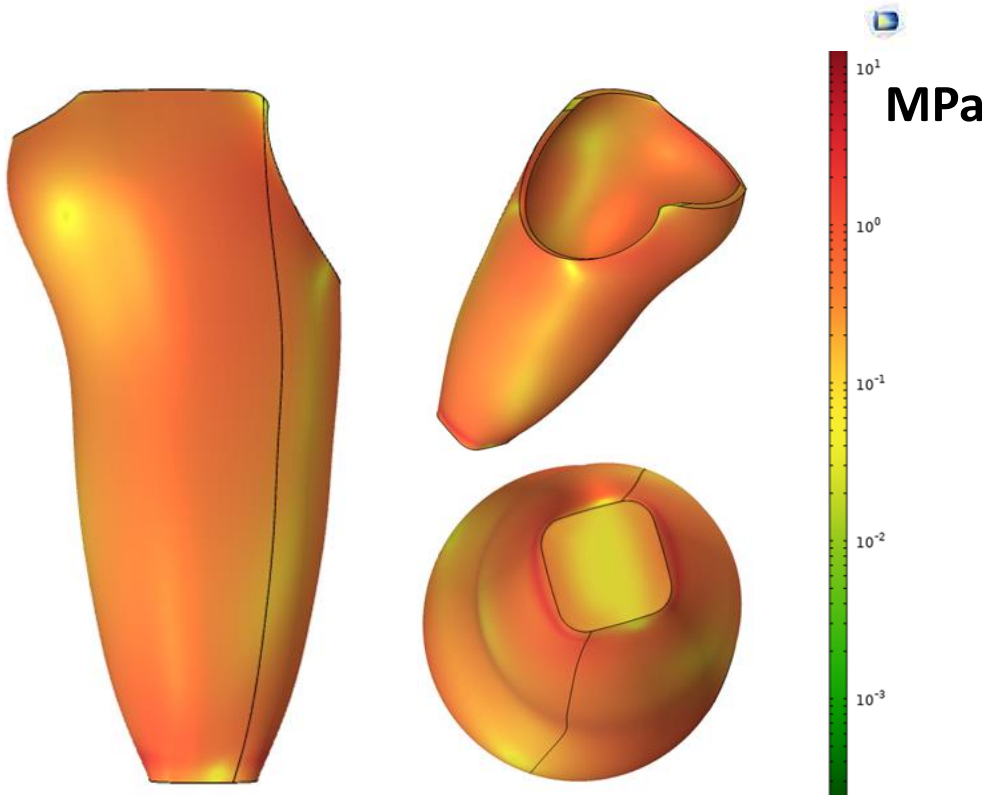
Methods

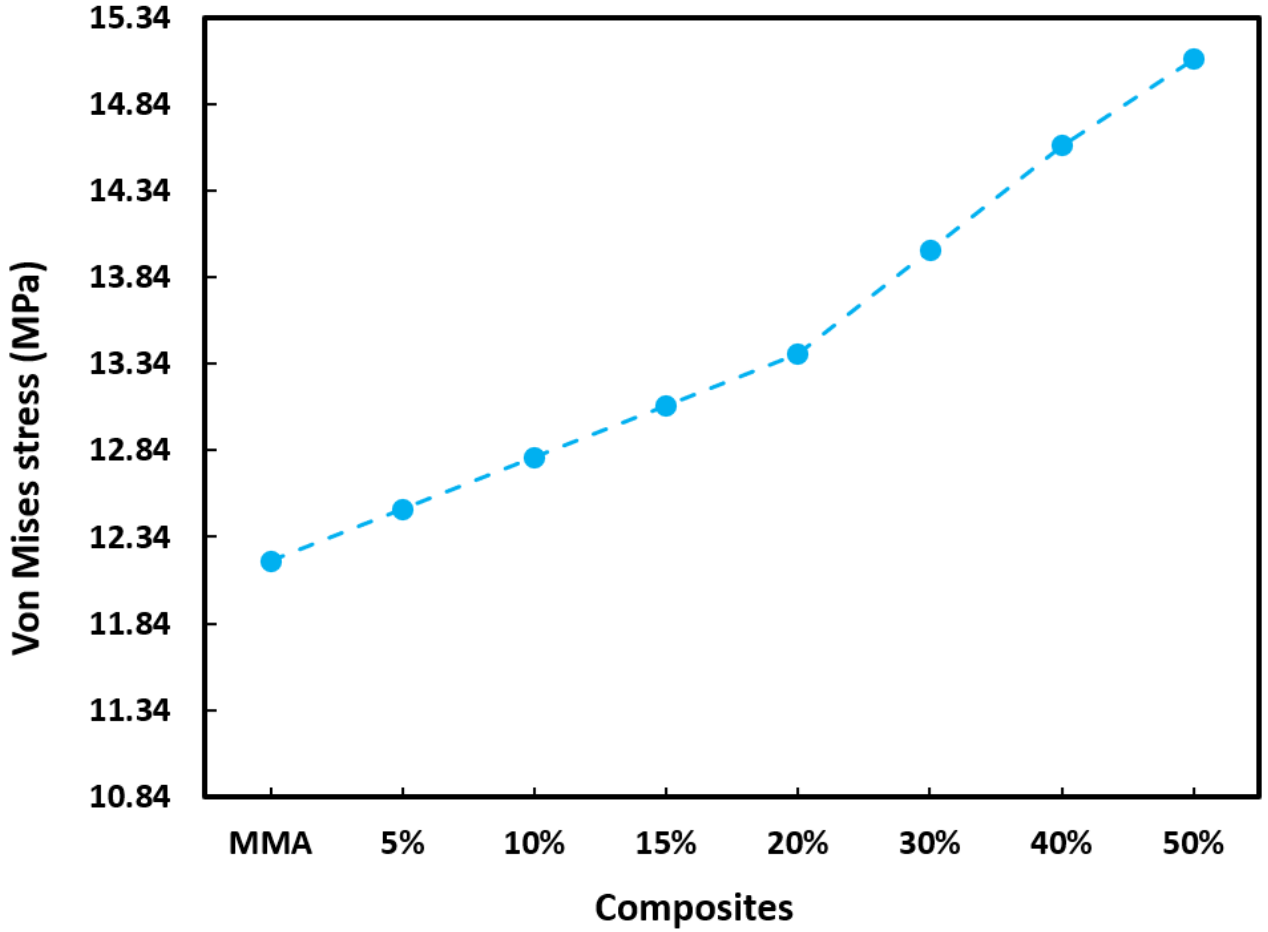
COMSOL Multiphysics?



Results

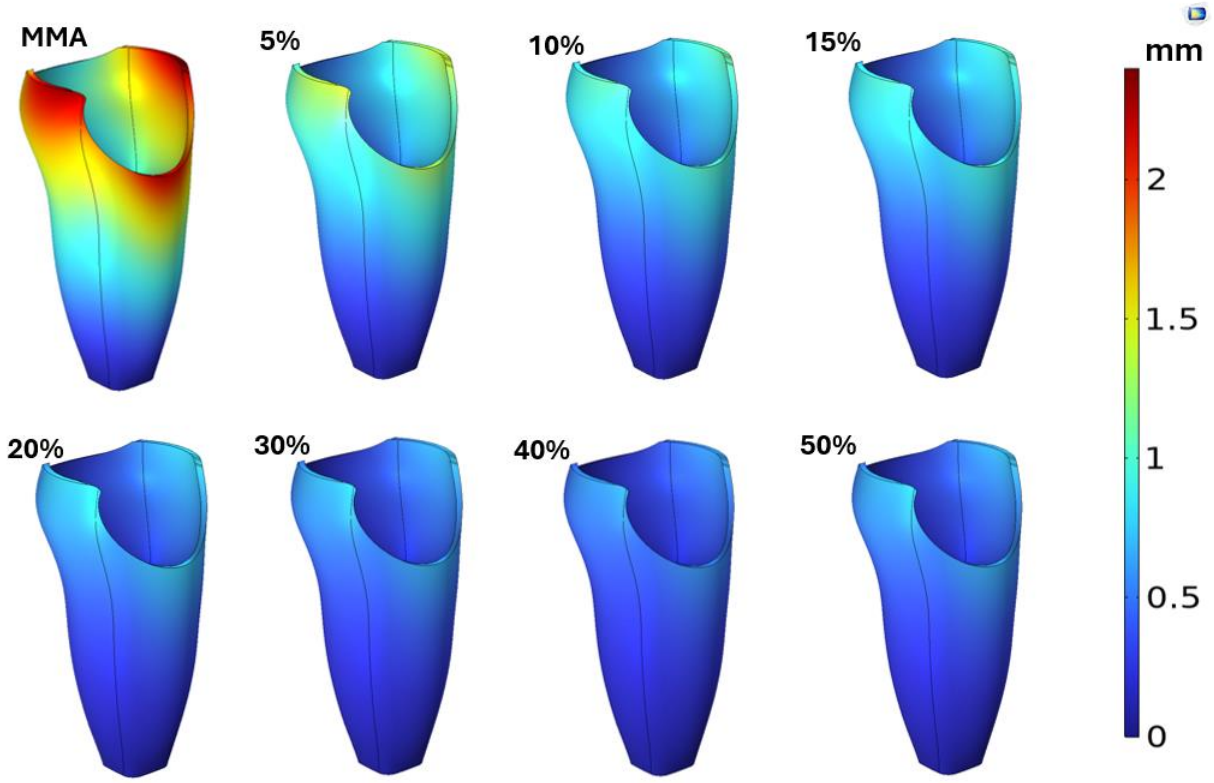
- **Stress pattern**

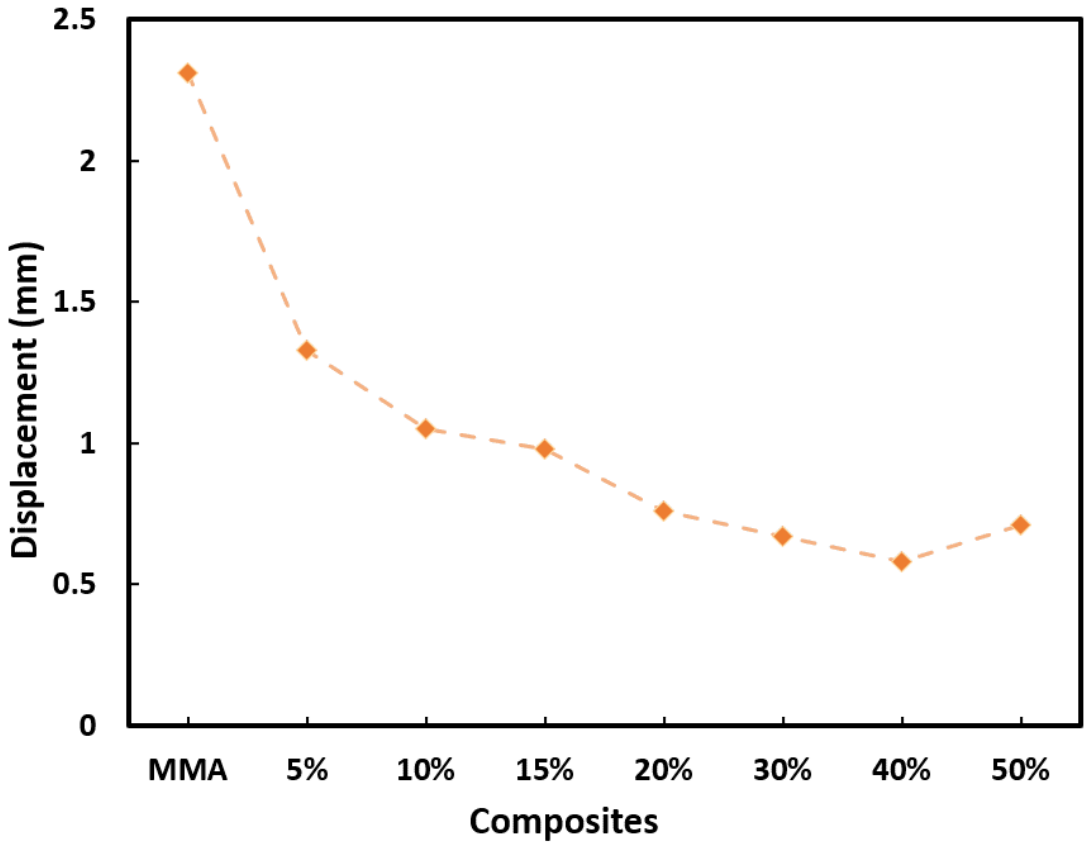




Results…cont’d

- **Deformation (Max)**

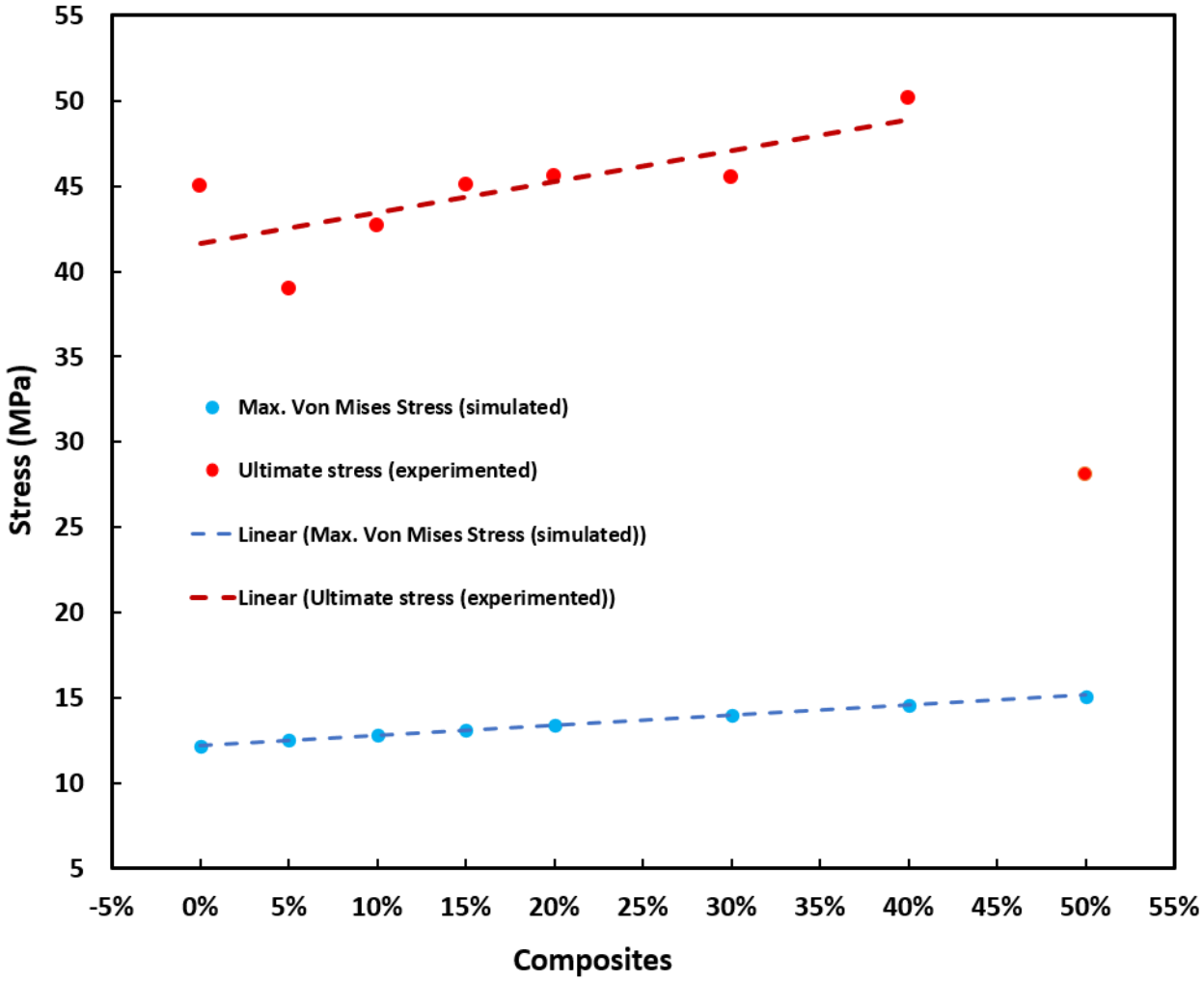




Conclusions

Impact of results on the project.

1. Insight on the range of PS stresses (12 - 15 MPa) given the boundary conditions.
2. Deformation patterns of the different PS composites.
3. Experiment vs Simulation
4. PALF composite material has the potential for prosthetic socket development depending on PALF volume fraction and type of resin.



Thank you for listening!

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